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CONSULTANT

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# PRINTED CIRCUIT DIGEST

*Biggest Little Magazine in Printed Circuitry*

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Weldable Circuits — Page 3



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## PRINTED CIRCUIT DIGEST

*This magazine is published by Electralab Electronics Corporation to report on subjects of interest to users and potential users of printed circuitry. Because this publication is intended to be a helpful service, there is no charge. Fellow editors may reproduce the material without permission although a credit to Electralab or the "Digest" would be appreciated.*

*Managing Editor ..... Doris Tannahill*

### CONSISTENT QUALITY

Everyone has a desire to do perfect work. Too often it is not expected as a natural result of best effort. It's too easy to make allowances by saying "no one is perfect." We admit the latter as unfortunately true, but not acceptable as a reason for poor workmanship.

Zero Defects is a great program and we sincerely subscribe to its principles. Visual aesthetic defects are undesirable but occasionally they present economic problems out of all proportion to the gain in removing them. We consider reliability a major goal, and function rather than appearance as the measure of success. If we seem to take pride in the "looks" also, it's because we do. It's a fair assumption that care in this area indicates the same meticulous attention in the hidden areas that really count. Fortunately our people who produce have no time or desire to distinguish between the critically important and that which may be less so.

For this and other obvious reasons, we find it necessary to confine our production to circuitry having tolerances and reliability requirements in excess of the ordinary. This gives us just one standard of performance: the best it is possible to obtain by our unique combination of skilled craftsmen working with and using effectively the finest equipment available.

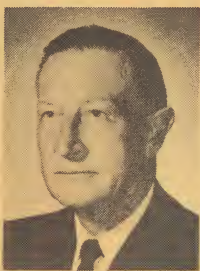
*Wells J. Huntley*



*President*

### ON THE COVER

*This photo shows a welded flat-pack attachment (an example of parallel-gap welding). The tab surfaces are weldable Alnifer with gold overplated. The board, a nine-layer Multilayer, is part of the Apollo "Man on the Moon" program. (Photo by Al Cordas.)*



## WELDABLE CIRCUITS

*by*

**CHARLES N. ELSBREE**

*Manager, Materials and Processes*

*Electralab Electronics Corporation*



Keeping pace with the ever-increasing demand for more reliable methods of flat-pack and component attachment is the recent increase in the use of "weldable" printed and multilayer circuit boards. Weldable circuits have "been around" for several years; but this recent upsurge has led to the discovery of improved processing techniques and the development of more compatible materials.

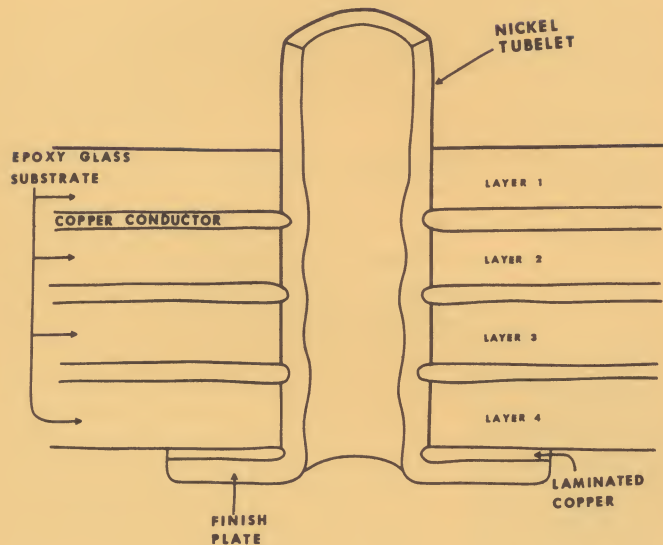
The proponents of welded packaging have for years extolled the reliability of resistive welding: "It is a controlled process with no heat damage, less total weight and absence of joint resistance." Circuit fabricators played a minor role since most weldable packaging was done using ribbon. Whenever circuit people were requested to work with weldable materials there were restrictions which were incompatible with circuit manufacturing processes and not understood by them. Therefore, the result many times was something less than desirable.

There are a number of methods of producing a weldable circuit. Because circuit fabricators are not welders they can only assume the resultant degree of weldability. The selection of the metal clad is the key to processing.

Materials most often used are copper, Kovar and Alnifer. These materials are, for the most part, well known to welders with the possible exception of Alnifer. Alnifer is a metal sandwich composed of aluminum, nickel and iron.

The preferred material from the circuit processing stand-

## MULTILAYER TUBELET



*This drawing illustrates a cross section of Multilayer tubelet utilizing Electralab's Multi-Con process for plated thru holes in multilayer. The tubelet, which is a continuation of the thru hole plating, extends above the surface of the board.*

point is copper. The copper may be welded to directly or over-plated with nickel or gold or both. The thru-hole connections would be copper.

The use of nickel is probably the most desirable from the welder's viewpoint, but the adhesion of nickel to the base laminate has not always been good. There are, however, a number of good materials now available. The major circuit fabrication problem being that of plating thru-connections and etching. Both of these difficulties have been alleviated with the development of thru-hole nickel plating techniques and specialized etchants.

Alnifer shows some promise. The purpose of the sandwich is aluminum next to the board for bond, iron in the center to block heat (which would affect the bond) and nickel for weldability. The thru connections may be copper, with the copper area restricted away from the weld tab, the final finish being gold plate. There are two major difficulties: Keeping the "blow out" (weld spatter of aluminum or iron) within the tab; and etching. In order to overcome

these restrictions, it was necessary to develop a specialized plating process and improved techniques to control the etching problem.

The use of Kovar has been limited because of the lack of availability of this material. The plating-thru problems and etching of Kovar, as with the other materials, are a major concern and are requiring additional work.

Directly relating to the attachment problem is the weldable cord-wood board. One of the more advanced solutions to this is an electro-formed tubelet.

A tubelet is electro-formed as an integral part of the circuit, thereby assuring the best possible performance. The tubelet is basically an extension of the thru-hole plating which is extended above the surface of the board. The height of the tubelet must be sufficient to provide a proper weld-interface, the typical tubelet being .020" to .030" in length. The tube may extend from one or two-sided circuit boards. A recent development permits even reliable multilayer tubelet boards.

Weldable circuitry manufactured by Electralab is currently playing a part in both the Apollo and Standard Missile programs. Weldables are also being researched and/or used by many other major military and aerospace suppliers.

The processing controls required to produce a weldable board are much more stringent than those required for conventional or even multilayer boards. But, with the processing problems that have been solved and the continuing research being carried on in this area by Electralab and others it appears that weldables are "here to stay" as standard specified items in today's design of high-density packaging, with applications in conventional as well as multilayer.





**Actor/Writer/Producer  
Oh Yes, and Photo Technician,  
That's Garry Johnston**

Garry Johnston, during his working hours at Electralab, is engaged with Graphic Arts projects. But during his free time he can be found with his camera.

He is currently producing creative "art" films in 16 mm, and soon will have a showing at an art theatre in La Jolla. His latest movie, "The Fourth Ring," is a story of an insane circus clown who comes upon a woman in a cemetery mourning the death of her husband. The clown tries to entertain her by doing several of his tricks, but his antics displease her. As a result, they have a dramatic argument. The feature was filmed in a local cemetery at Olivenhain.

Garry's first movies were of a much lighter nature, mostly in a comedy vein. One for example is "Superb-Man," a "Poor Soul" of a super hero who cannot change into "Superb-Man" garb. Because of this he is unable to save a maiden in distress.

The switch from comedy to drama illustrates Garry's versatility in expression and subject.

Interest in his projects has steadily increased. His comedy features "Superb-Man" and "Flashy Gordon" have been shown on "Sundown," a local TV program. He did a satire on TV commercials which appeared on the coast-to-coast TV show "Your Funny Funny Films."

We are happy to have Garry at Electralab, and wish him luck in his future productions.

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## NEW AND NOTEWORTHY

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### OLD/NEW NEWS

It may be new news to some of you that Electralab's processes carry the approval of The Underwriter's Laboratory. Gold and solder plated board samples were submitted for testing and passed the rigid requirement standards of that Agency.

### A MAN OF QUALITY

As Electralab's new Quality Assurance Manager, Robert F. Martin is responsible for all of our quality activities. Always a specialist in quality, Bob comes to us from General Dynamics/Convair and Electronics.

### SUIT-UP

Our technicians in the "White Rooms" are wearing the latest in fashion. Fine Dacron suits with stylish hats, gloves and shoe coverings to match. The color of the season is white, of course.

### MANAGER/AUTHOR

Chuck Elsbree has been appointed Manager of Materials & Processes at Electralab. With many years of experience in circuit processing, this appointment comes almost simultaneously with Chuck's being elected Vice-President of the San Diego Section of the American Electroplaters' Society. (P.S.: Chuck also wrote the lead article for this issue of the Digest, see Page 3.)

### NEW REPRESENTATIVES

Elcom, Inc., of Glenside, Pennsylvania, now represents Electralab in the Eastern Pennsylvania area. The Eastern Wisconsin area is covered by E. A. Dickinson & Associates, located in Milwaukee.

### TROPHY DEPARTMENT

The Men's Industrial Handicap Bowling League has finished its season. Electralab's Team No. 3, although finishing 7th in a field of 8, came in first place in the trophy department. Each team member gets a trophy for High Team Series and Al Sany of the Machine Shop gets another for High Individual Series.

### CUSTOMER SERVICE ENGINEERS

Mark Riley and Morry Guy have been appointed Customer Service Engineers. They will assist customers in the areas of technical liaison and service.